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FOREST SURVEY RELEASE NO. 36 OCTOBER 3, 1938

FOREST RESOURCES

of the

OUACHITA MOUNTAIN REGION OF ARKANSAS

A Progress Report

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THE SOUTHERN FOREST SURVEY

I. F Eldredge

Regional Survey Director

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E. L. Demmon, Director

New Orleans, La.

FOREWORD

The nation-wide Forest Survey, being made by the United States Forest Service, was authorized by the McSweeney-McNary Forest Research Act of 1928. Its five-fold object is : (1) to make an inventory of the present supply of timber and other forest products, (2) to ascertain the rate at which this supply is being increased through growth, (3) to determine the rate at which this supply is being diminished through industrial and local use, windfall, fire, and disease, (4) to determine the present requirement and the probable future trend in the requirement for timber and other forest products, and (5) to correlate these findings with existing and anticipated economic conditions, in order that policies can be formulated for the effective use of land suitable for forest production.

This release is based on a field survey made April 25, 1936, to June 13, 1936, and on a field canvass of forest industrial plants to determine forest drain, which was completed during March, 1937. It should be regarded only as a progress report since it contains Forest Survey data that will be included in complete reports to be published later, and that, although considered reliable, are subject to correction or amplification as the work of computation proceeds. Item 4 above, which is being studied on a national basis, is not discussed in this report.

In the presentation of these survey data, it is to be noted that owing to the sampling method used in collecting them, the greater the number of samples in any given classification the more accurate are the data for that classification. Hence classes that are of infrequent occurrence and relatively small in quantity generally cannot be determined with as high a degree of accuracy as classes that occur more frequently and in substantially greater quantities. Small tabular items are to be taken as showing, not the exact magnitude of the classes involved, but their relative magnitude in comparison with those of other classes.

In the South, the Forest Survey functions as an activity of the Southern Forest Experiment Station with headquarters at New Orleans, La.

Staff Assignment

In Charge of Field Work and Preparation of Report
James W. Cruikshank - Associate Forest Economist

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Note: The Southern Forest Experiment Station hereby wishes to acknowledge the clerical assistance received from the Works Progress Administration in the preparation of this Release.

FOREST RESOURCES OF THE OUACHITA MOUNTAIN REGION OF ARKANSAS

General Description of the Unit

The Ouachita Mountain region of Arkansas is a rugged, timbered area extending fanwise from Little Rock westward to the Oklahoma state line. The Arkansas River forms the northern boundary, and the southernmost ridges of the Ouachita Mountains approximate the southern limits of the area (map, fig. 3). It includes all of 9 counties and part of 3 others, totaling 4,917,700 acres. All but a very small portion of the Ouachita National Forest within the State of Arkansas is included in this unit. The cities of Little Rock and Fort Smith, both on the Arkansas River, are important industrially, while Hot Springs is widely known as a health resort.

Omitting Pulaski County, in which Little Rock is located and where the population is largely urban, agriculture furnished employment to about 42 percent of those working in 1930. Although a large proportion of the population was engaged in farming, a majority of the farmers drew a part of their support from forests and forest activities. About 500 families were partly dependent upon the National Forest for support in 1936. The Survey (made in 1936) found that 69 percent of the unit area was forest land, 16 percent was in cultivation, and that over much of the area farms and forests bear an intimate relation to each other.

Topographically, the area includes a part of the Arkansas Valley and the Ouachita Mountains, which together make up the Ouachita Province of the Interior Highlands of Arkansas. The portion of the Arkansas Valley lying within the unit is about 35 miles wide at Fort Smith but gradually becomes narrower, until at the northeast corner of Perry County the Arkansas River cuts through the hills to Little Rock and the Mississippi Delta. The Valley is a rolling plain, 300 to 600 feet above sea level, broken by several ridges and broad-topped mountains; Magazine Mountain, the highest in the State, rises as high as 2,823 feet. The Ouachita Mountains are made up of numerous ridges, most of which run in an east-west direction. Near Little Rock the ridges lack uniform direction and have elevations of only 500 to 700 feet above sea level, but progressing westward the ridges and mountains become higher; Rich Mountain achieves an elevation of about 2,900 feet just across the line in Oklahoma. The area is drained by the Arkansas, Ouachita, Saline, Petit Jean, Fourche La Fave, and Little Missouri Rivers, all of which flow southward or eastward. Stream flow is erratic and rapid runoff from the uplands cause local flood problems of considerable magnitude.

Four main-line railroad systems serve the unit, and are located chiefly along the boundaries. The interior of the unit is served only by branches of these main lines, supplemented by a few local railroads originally constructed for transporting forest products. Owing to the character of the terrain, the lack of diversified industrial development, the scarcity of the population, and the large area in National Forest, in the future the railroad mileage probably will decrease rather than increase. Except on the Ouachita National Forest, highway development is limited to a few through routes not all of which are

paved. On the National Forest, many roads constructed by the Civilian Conservation Corps have opened up numerous forest areas hitherto difficult of access. The Corps of Engineers defines as navigable streams in the unit, the Arkansas, 25 miles of the Petit Jean, and 27 miles of the Fourche La Fave, but much expensive channel improvement will be required to make these year-round waterways.

In 1930 the human population was about 315,000, nearly half of whom lived in the three largest cities of the unit: Little Rock, Fort Smith, and Hot Springs. Since 1910 these cities have had a steady growth, while the rural areas have been decreasing in population. Between 1920 and 1930 there was a population decrease of 3 to 22 percent in all counties in the unit except Pulaski and Garland. During the same period Pulaski County had an increase of over 25 percent, while Garland County, in which Hot Springs is located, had an increase of 40 percent. For the unit as a whole, 35 percent of the population is rural; 20 percent lives in towns of less than 2,500 and 45 percent in cities.

According to the Census of 1935 there were 24,900[1/] farms in the unit. These farms contained 1,870,000 acres, of which 40 percent were in woods. The average farm contained 75 acres, with 29.5 acres in cropland, 29.8 acres in woodland, 11.3 acres in open pasture, and 4.4 in miscellaneous uses. Number of farms and total land in farms increased slightly between 1930 and 1935, although land available for crops decreased. General farming is practiced, with cotton, corn, live stock, fruit, and truck crops produced in every county. Appreciable quantities of Irish potatoes are grown for market in Sebastian and Logan Counties, while Sebastian, Pulaski, and Scott Counties produce large quantities of strawberries.

The largest area of land in single ownership is the Ouachita National Forest, where 1,035,830 acres were under Federal Forest Service administration on June 30, 1937. National and State Parks contain 8,600 acres. The Farm Security Administration owned about 130,000 acres near Magazine Mountain in 1938, but steps are being taken to transfer this land to the Forest Service. Farm lands amounted to about 1,870,000 acres in 1935. Of the 24,900 individual farms, 53 percent were operated by their owners, 36 percent by tenants, and 11 percent by sharecroppers. At the present time there are only three large lumber companies operating in this area, and at least two of these own extensive acreages of timber land.

Tax delinquency is somewhat greater here than in the more productive Coastal Plain Counties to the south. Land in tax default for 3 or more years and forfeited to the State amounted to about 5 percent of the gross land area on Jan. 1, 1934.

Table 1 shows that nearly 70 percent of the land area of the unit is used for timber production. It is probable that the idle and abandoned farm land, totaling over 6 percent of the area, will also revert to forest land unless the demand for agricultural products increases greatly.

1/ Includes all the farms in Pulaski County, and excludes all those in Franklin and Conway Counties.

Table 1. - Land area classified according to land use

Land	Area	Proportion of total area
	- - - - Acres - - - -	- - - Percent - - -
Forest:		
Productive	3,376,900	68.7
Nonproductive	1,600	negl.
Total forest	3,378,500	68.7
Nonforest:		
Agricultural:		
In cultivation:		
Old cropland	778,400	15.8
New cropland	24,000	0.5
Out of cultivation:1/		
Idle	196,600	4.0
Abandoned	113,500	2.3
Pasture	253,400	5.2
Total agriculture	1,365,900	27.8
Other nonforest	173,300	3.5
Total nonforest areas	1,539,200	31.3
Total forest and nonforest	4,917,700	100.0

1/ Potential forest land.

Description of the Forest

Shortleaf pine is the predominant species in the forest, generally occurring in pure stands on the lower slopes of the east-and-west ridges. On the upper elevations of these slopes, and in the narrow valleys, the pines are mixed with various hardwoods, of which the white oak is the most valuable. Pure stands of upland hardwoods, made up of such species as red oak, white oak, hickory, and red gum, are found throughout the unit but occupy most extensive areas in Sebastian, Franklin, Logan, and Yell Counties (fig. 3). In the river bottoms, which have a relatively small acreage, red gum is the most abundant species, although water oak, white oak, ash, and hickory are common.

Since a large proportion of the land area is forested, timber stands are found in all of the topographic situations represented in the unit. It is common practice, however, to cultivate the more fertile stream bottoms and the abutting gentle slopes, leaving the rocky ridges with their thin soils and steep slopes in forests, so that the amount of forest land in the valleys is relatively low. Table 2 gives the acreage of the four type-groups and their occurrence by topographic situation.

Table 2. - Forest area classified according to forest type-group and topographic situation

Forest type-group	Slope			River bottom	Total	Proportion of total
	10 percent or less	More than 10 percent				
		North	South			
	Acres					Percent
Pine	520,300	489,100	549,100	4,800	1,563,300	46.3
Pine-hardwood	285,300	275,800	235,800	6,400	803,300	23.8
Upland hardwood	382,900	326,100	192,600	-	901,600	26.7
Bottomland hardwood	-	-	-	108,700	108,700	3.2
Total all types	1,188,500	1,091,000	977,500	119,900	3,376,900	100.0
Percent of total forest area	35.2	32.3	28.9	3.6	100.0	

Shortleaf pine is the dominant species in the pine type-group, but small quantities of loblolly are present in the extreme southern part of the unit where the location is low and moist enough to favor its development. Almost one-third of the pine type-group acreage is stocked with stands of old-growth timber and about half with second-growth sawlog-size stands (table 3). In the pine-hardwood type-group, shortleaf is also the leading pine species, while forked-leaf white oak and post oak are the most common hardwoods. In this type-group, sawlog-size stands are found on 46 percent of the type-group area, while 54 percent is stocked with young stands not yet of saw-timber size. Only 14 percent of this area is in old-growth stands.

The upland hardwood type-group has nearly three-fourths of its area stocked with stands which are at present below saw-timber size. Some of these are located at the higher elevations along the ridge tops, and because soil and climatic conditions are unfavorable to rapid growth they may remain below sawlog size for many years; less than one-fifth of the type-group area is occupied by stands classified as old growth. The bottom-land hardwood type-group is limited to slightly over 100,000 acres; 21 percent of this acreage supports old growth stands, 28 percent second-growth sawlog-size stands, and 51 percent stands below sawlog size.

Table 3. - Forest area classified according to forest condition and forest type-group

Forest condition	Pine	Pine-hardwood	Upland hardwood	Bottom-land hardwood	Total all types	Proportion of total
			Acres			Percent
Old growth:						
Uncut	371,600	66,300	89,600	8,800	536,300	15.9
Partly cut	86,300	49,600	66,300	13,600	215,800	6.4
Total	457,900	115,900	155,900	22,400	752,100	22.3
Second growth:						
Sawlog size:						
Uncut	597,800	171,100	64,700	17,600	851,200	25.2
Partly cut	215,000	81,500	38,400	12,800	347,700	10.3
Under sawlog size	281,400	430,800	600,200	52,800	1,365,200	40.4
Reproduction	6,400	3,200	42,400	3,100	55,100	1.6
Total	1,100,600	686,600	745,700	86,300	2,619,200	77.5
Clear-cut	4,800	800	-	-	5,600	.2
Total all conditions	1,563,300	803,300	901,600	108,700	3,376,900	100.0
Percent of total forest area	46.3	23.8	26.7	3.2	100.0	

The species composition of the four type-groups shown in table 3 is graphically presented in figure 1, where the net cubic volumes of each of the four species groups — (1) pines, including a negligible quantity of cedar, (2) gums and other pulping hardwoods, (3) oaks, including scrub oak, and (4) hickory and other nonpulping species —— are expressed as a percentage of the total net cubic volume in the individual type-group. The pine component of the pine type-group makes up nearly 89 percent of the type-group volume, and most of this is shortleaf pine. In the pine-hardwood type-group, over half the cubic volume is shortleaf pine with forked-leaf white oak the most conspicuous hardwood. The most abundant species in the upland hardwood type-group are the oaks, in which red, forked-leaf white, and post oaks occur in descending order, with hickory next in abundance. Red gum and water oaks are the most common species in the bottom-land hardwood type-group.

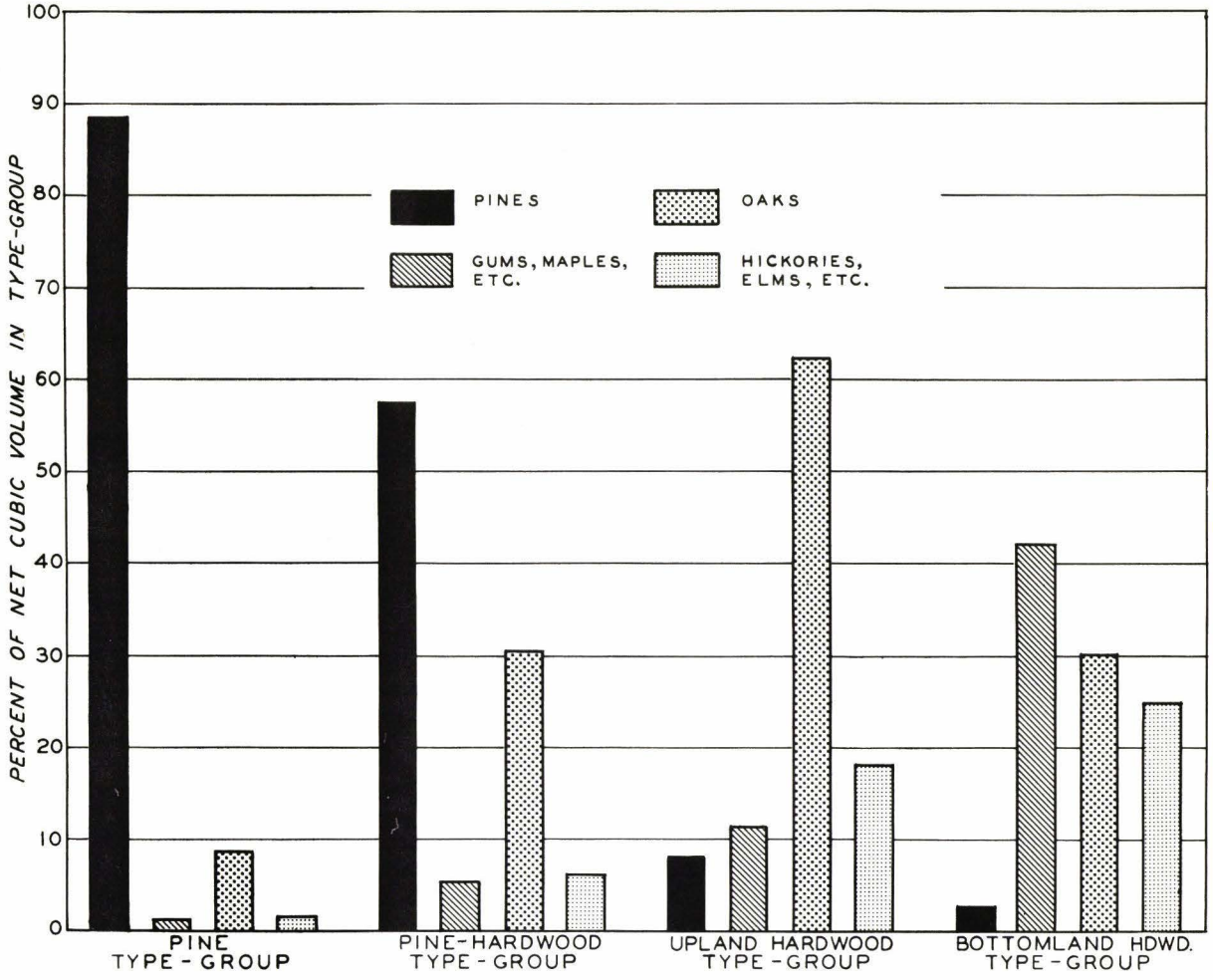

FIGURE 1 – SPECIES COMPOSITION OF FOREST TYPE-GROUPS.

In figure 2 the age-class and volume distribution on the present pine and pine-hardwood forest area is compared with that of a hypothetical managed forest of the same general type handled on a rotation of 80 years. A rotation of this length should produce saw timber, poles, piles, and pulpwood in the mountainous Ouachita region, where growth is somewhat slower than in the Coastal Plains to the south. As shown in the figure, the managed forest is divided into 8 equal areas, each containing one 10-year age-class. The per-acre volumes are based upon the present best stocked 10 percent of the uncut forest stands of weighted average site in the pine and pine-hardwood types. The portion of the figure showing the prevailing age-classes and volumes represents a rough division of the 2,366,600 acres in the present forest into areas characterized by the dominance of certain age-classes, on the basis of their occurrence in the present forest. The volume per acre shown for a specific age-class is the average of all the stands, good and poor, in that class.

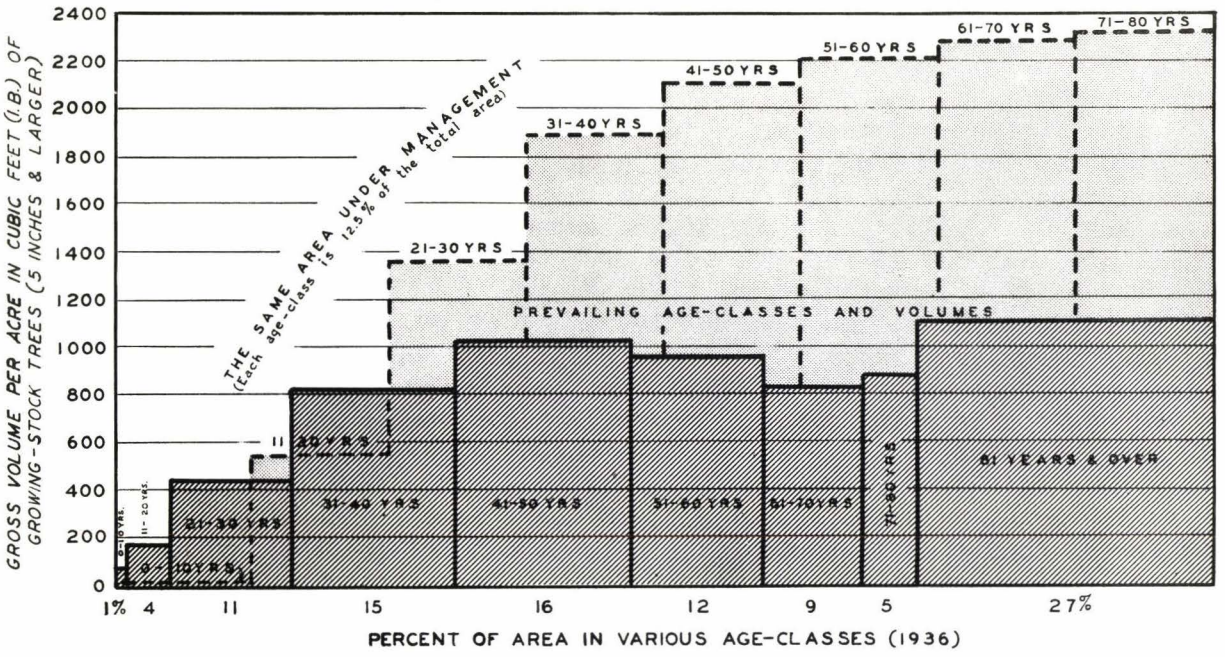

FIGURE 2 - **PREVAILING AGE-CLASS AND VOLUME DISTRIBUTION COMPARED WITH THAT ON THE SAME AREA UNDER MANAGEMENT** (BASED ON PINE AND PINE-HARDWOOD TYPE-AREA OF 2,366,600 ACRES).

A study of figure 2 brings out the following points concerning the present pine and pine-hardwood forest: (1) It is deficient in stocking, in that it contains only 55 percent of the volume shown in the managed stand; (2) the distribution of age-classes by area is irregular, in that the area in the youngest age-class is only one-twelfth of what it should be, while the area in the 80-year-and-over age-class is not needed for an 80-year rotation; (3) the areas in the five age-classes between 21 and 70 years closely approximate those of the managed forest. Theoretically, an approach to the ideal distribution by area of the age-classes might be achieved gradually through cutting half the area in the oldest age-class in the next 10 years, and converting these areas into the young age-classes needed at the other end of the rotation.

Volume Estimates

Board-foot volume

The estimate of the volume in sound saw-timber trees is given in table 4, expressed in terms of board feet, as measured by the Doyle log rule. Hardwoods included in this estimate were at least 13.0 inches in diameter at breast height (d.b.h.) outside bark, and pines 9.0 inches; and all trees contained at least one 12-foot butt log, or had 50 percent of their gross volume in sound material. Top diameters varied with the limits of usable material, but no hardwood logs less than 8.5 inches in diameter at the small end nor any pine logs less than 5.5 inches were included. Deductions were made for woods cull, such as rot, fire-scar, crook, limbiness, and similar defects, as well as for loss in sawing at the mill due to sweep and hidden defects, so that the volumes given here may be considered net log scale.

The total volume of 4,201,300,000 board feet is shown by species-group and forest condition in table 4. Eighty percent of the total volume is pine, over half of which is in old-growth stands. In the hardwoods also, over half the volume is in old-growth stands, with white and red oaks the leading species. Although not shown in table 4, it is interesting to know that two-thirds of the pine volume is in trees 13.0 inches d.b.h. or over. It is impossible to say definitely how much of the total board-foot volume can be considered available for utilization at the present time, as the mountainous topography and scarcity of transportation facilities make logging difficult in certain areas. In the Ouachita National Forest, which includes about 30 percent of the forest land in the unit, the management policy requires the distribution of the cutting of the existing saw-timber volume over a long period of time; consequently, only a part of the area and volume can be depended upon to supply the immediate needs of the existing industries. In the next 10 years, probably not more than 350 million board feet of Forest Service timber will be cut. This will be replaced by an equal or greater amount through the increment of the reserved growing stock left on the areas cut over, and will be supplemented by the increment accumulating on areas now classed as inoperable because of thin stands or temporary inaccessibility.

Although the Doyle rule is the legal rule of Arkansas, a more correct measure of the actual recoverable volume is obtained with the International $\frac{1}{4}$-inch rule, which, as used in this report, is the equivalent of green lumber tally. According to table 5, the volume is nearly 7 billion board feet when measured by this rule, an over-run of 65 percent above the Doyle scale.

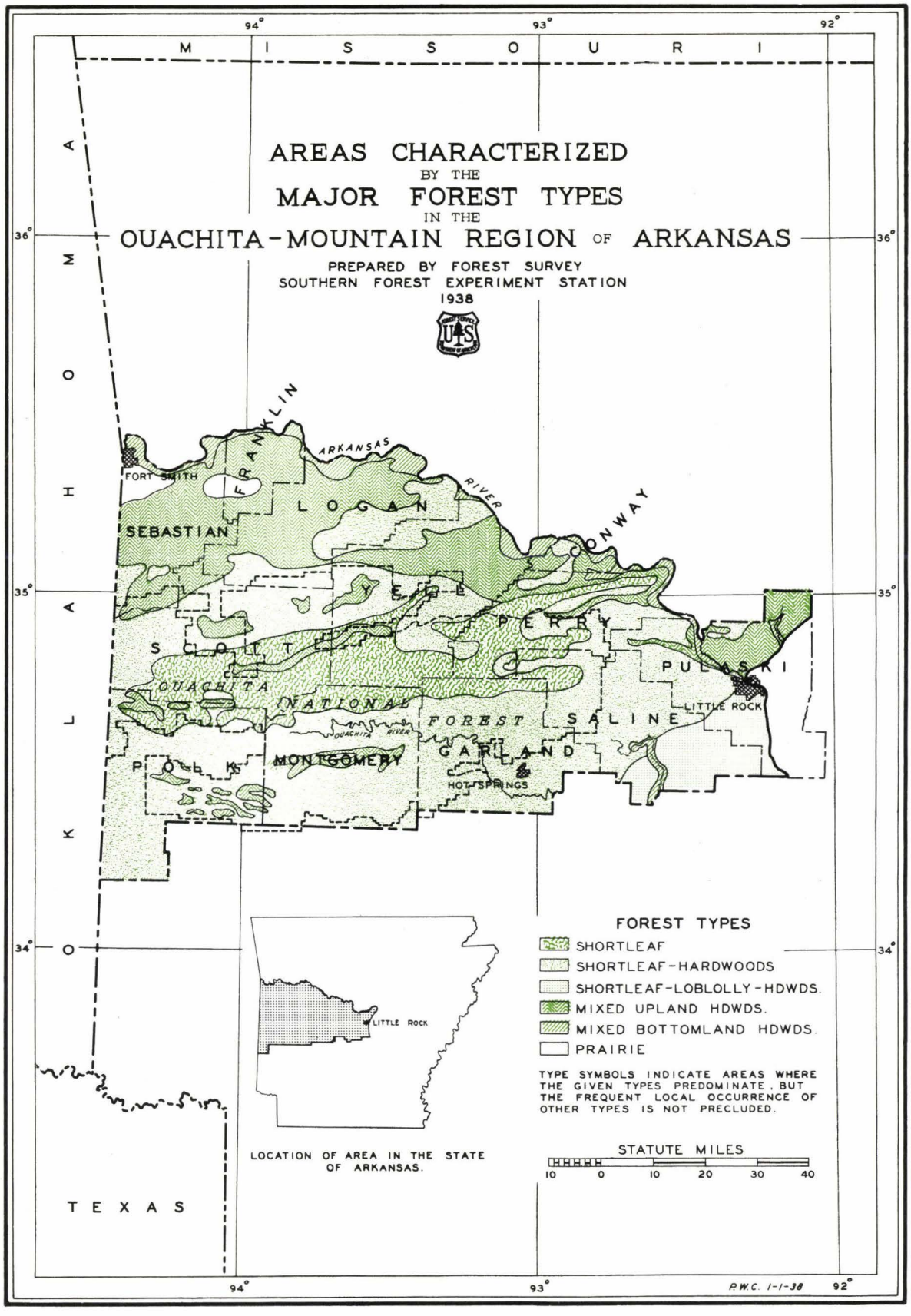

FIGURE 3 - FOREST TYPE MAP.

Table 4. - Net volume (Doyle) classified according to species-group and forest condition

Species-group	Old growth		Second growth		Total	Proportion of total
	Uncut	Partly cut	Sawlog size	Under sawlog size 1/		
	Thousand board feet					Percent
Pines:						
Shortleaf	1,576,400	232,300	1,265,100	96,800	3,170,600	75.5
Loblolly 2/	1,700	900	198,800	2,600	204,000	4.8
Total pines	1,578,100	233,200	1,463,900	99,400	3,374,600	80.3
Pulping hardwoods:						
Red gum	14,400	23,600	56,400	3,800	98,200	2.3
Black and tupelo gums	14,200	9,000	18,100	6,000	47,300	1.1
Other 3/	5,300	9,200	4,800	900	20,200	.5
Nonpulping hardwoods:						
Red oaks	63,400	43,700	82,000	22,000	211,100	5.1
White oaks	93,300	37,200	50,500	32,800	213,800	5.1
Post oaks	31,400	33,000	44,600	30,700	139,700	3.3
Hickories	13,600	9,600	14,500	7,800	45,500	1.1
Others	13,200	7,800	23,300	6,600	50,900	1.2
Total hardwoods	248,800	173,100	294,200	110,600	826,700	19.7
Total all species	1,826,900	406,300	1,758,100	210,000	4,201,300	100.0
Percent of total	43.5	9.7	41.8	5.0	100.0	

1/ Includes 2.5 million feet on areas classified as reproduction and clear-cut.
2/ Includes 1.7 million board feet of cedar.
3/ Species not commercially pulped at present, although certain species have been used experimentally.

The old-growth stands occupy only 22 percent of the forest area, but they contain 46 percent of the board-foot volume shown in table 5. Of this volume in old-growth timber, amounting to nearly 3¼ billion board feet, 82 percent is pine, 3 percent is red and black gum, and 15 percent is oak, hickory, and other miscellaneous species. Analyzing the volume per acre by type-groups, it is found that in the old-growth uncut condition, the pure pine type-group averages 5,820 board feet per acre, the pine-hardwoods average 3,380, the upland hardwoods 2,060, and the bottom-land hardwoods 5,150 board feet, lumber tally.

Table 5. - Net volume, lumber tally, classified according to species-group and forest condition (based on International $\frac{1}{4}$-inch rule)

Forest condition	Pines	Red and black gums etc.	Red and white oaks etc.	Total
		Thousand board feet		
Old growth:				
Uncut	2,275,500	46,300	294,700	2,616,500
Partly cut	358,600	57,300	178,700	594,600
Second growth:				
Sawlog size	2,900,700	120,100	315,100	3,335,900
Under sawlog size 1/	221,700	16,900	149,400	388,000
Total all conditions	5,756,500	240,600	937,900	6,935,000

1/ Includes areas classified as reproduction and clear-cut.

Second-growth stands occur on 78 percent of the forest area and contain 54 percent of the board-foot volume, amounting to 3-3/4 billion board feet, lumber tally. About 84 percent of this volume is pine, 4 percent red and black gums, and 12 percent oaks and other hardwood species. Average stands per acre are considerably lower than in the old-growth condition; for example, in the uncut second-growth sawlog-size stands of the pure pine type-group, the average volume per acre is 3,530 board feet, in the pine-hardwoods it is 2,170 board feet, in the upland hardwoods 1,460, and in the bottom-land hardwoods 2,260. The uncut second-growth stands thus have 29 percent (in the upland hardwoods) to 56 percent (in the bottom-land hardwoods) less volume per acre than the old-growth stands. Although the second-growth stands have a smaller volume per acre, the proportions of the species represented are very similar to those in the old-growth stands.

Figure 4 presents graphically the frequency of occurrence of various volumes per acre, based on stands in the sawlog-size conditions in the pine and pine-hardwood types. Gross volumes used are measured by the International $\frac{1}{4}$-inch rule. The two volume-per-acre classes stocked with less than 2,000 board feet per acre are weak statistically when considered separately, but when combined they are a reliable basis for the statement that 30 percent of the area contains less than 2,000 feet per acre and has 10 percent of the volume; the more heavily stocked stands on the remaining area (70 percent) contain 90 percent of the volume. It is significant that more than half the total volume is found in stands of at least 5,000 board feet per acre, occurring on about one-fourth of the forest area.

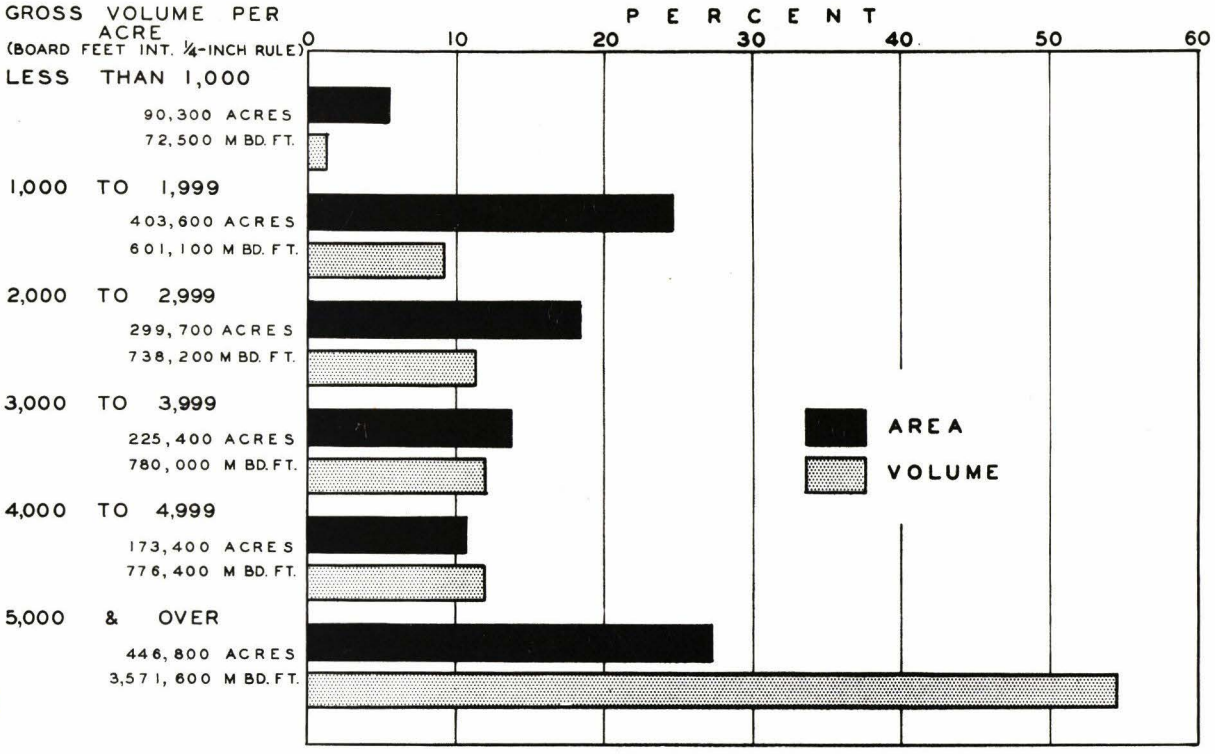

FIGURE 4 — PROPORTIONAL AREA AND VOLUME OF THE SAWLOG-SIZE CONDITIONS IN THE PINE AND PINE-HARDWOOD TYPES, CLASSIFIED ACCORDING TO VOLUME OF SAW TIMBER PER ACRE.

Cordwood volume

The estimate of cordwood volume, as shown in table 6, includes the entire stand of sound trees at least 5.0 inches d.b.h., outside bark, and in addition the net sound volume in cull trees 5.0 inches d.b.h. or larger. These volumes are expressed in terms of standard cords (4 x 4 x 8 feet), containing 90 cubic feet of wood and bark in the case of pine and cypress, and 80 cubic feet in that of hardwoods. The volume shown in table 6 under "sound trees sawlog size" includes only the merchantable sawlog portion of saw-timber trees, while the remaining portion of the stem (i.e., the upper stem) taken to a variable diameter, but not less than 4 inches, is given under "upper stems of sawlog-size trees." In pines the "upper stems" include only the stem, but in the hardwoods the usable limbs to a 4-inch minimum diameter are also included. "Sound trees under sawlog-size" include no limbs but do include the full stems of both pines and hardwoods to a variable usable top-diameter (not less than 4.0 inches). The volume shown under "cull trees" is the estimated sound usable portion in their stems. Deduction from the volume of all trees is made for woods cull, such as rot, fire-scar, crook, bad knots, and other defects. Although the volume shown for "upper stems" and cull trees is not being generally used, it is a potential source of supply.

In table 6 the total volume of sound material amounts to nearly 22 million cords of pine, 2-2/3 million cords of pulping hardwoods, and about 14 million cords of nonpulping hardwoods. In the pines, 58 percent of the material is in the merchantable portion of saw-timber trees, 7 percent in the upper stems of these same trees, 33 percent in trees below sawlog size, and 2 percent in the sound portion of the sound and rotten cull trees. In the hardwoods considered suitable for commercial pulping, it is noteworthy that 31 percent of the sound material is found in cull trees. The volume of the nonpulping hardwoods expressed in cords is largely found in sound trees below sawlog size (37 percent) and in the sound portions of the cull trees (34 per cent).

Table 6. - Net volume in various classes of sound material, expressed in cords of rough wood

Species-group	Sound trees sawlog size	Upper stems of sawlog-size trees	Sound trees under sawlog size	Cull trees	Total all classes	Proportion of total
			Cords			Percent
Pines	12,680,600	1,481,100	7,343,100	330,500	21,835,300	58.6
Hardwoods:						
Pulping	609,300	319,200	879,100	811,200	2,618,800	6.8
Nonpulping	2,634,100	1,492,000	5,207,800	4,769,200	14,103,100	36.6
Total hdwds.	3,243,400	1,811,200	6,086,900	5,580,400	16,721,900	43.4
Total all species	15,924,000	3,292,300	13,430,000	5,910,900	38,557,200	100.0
Percent of total	41.3	8.5	34.8	15.4	100.0	

Although the total volume for all species given in table 6 includes the saw-timber portion of sawlog-size trees, amounting to 41 percent of the total cordwood volume, it is not likely that any large amount of this saw-timber material will be utilized as pulpwood. At the present time there are no pulp mills within the unit. The nearest mill is located at Camden, 65 miles south of the unit. Should a demand for pulpwood develop, it would be sound policy to limit cutting in saw-timber stands to those trees which are of slow growth and of poor form and quality, reserving the better individuals for saw timber, poles, or other products more valuable than pulpwood.

The total supply of material on hand, over 38½ million cords, seems at first appraisal to be sufficient to meet the needs of present industrial establishments and provide for new requirements, but it must be remembered that only the increment on forest growing stock is the correct long-time basis for industrial development. Then, too, present industrial installations have a considerably greater combined capacity than their present cut and may need any apparent surplus of material now existing.

The net volume of sound trees measured in cords is shown in figure 5, classified according to species-group and diameter-class. This sound volume includes the full stems of pines and hardwoods under sawlog size but at least 5.0 inches d.b.h., the full stems of merchantable pines to a minimum variable 4-inch top, and the saw-timber portion of sawlog-size hardwoods. The volume in cull trees, scrub oaks, and tops and limbs of merchantable hardwoods is not included.

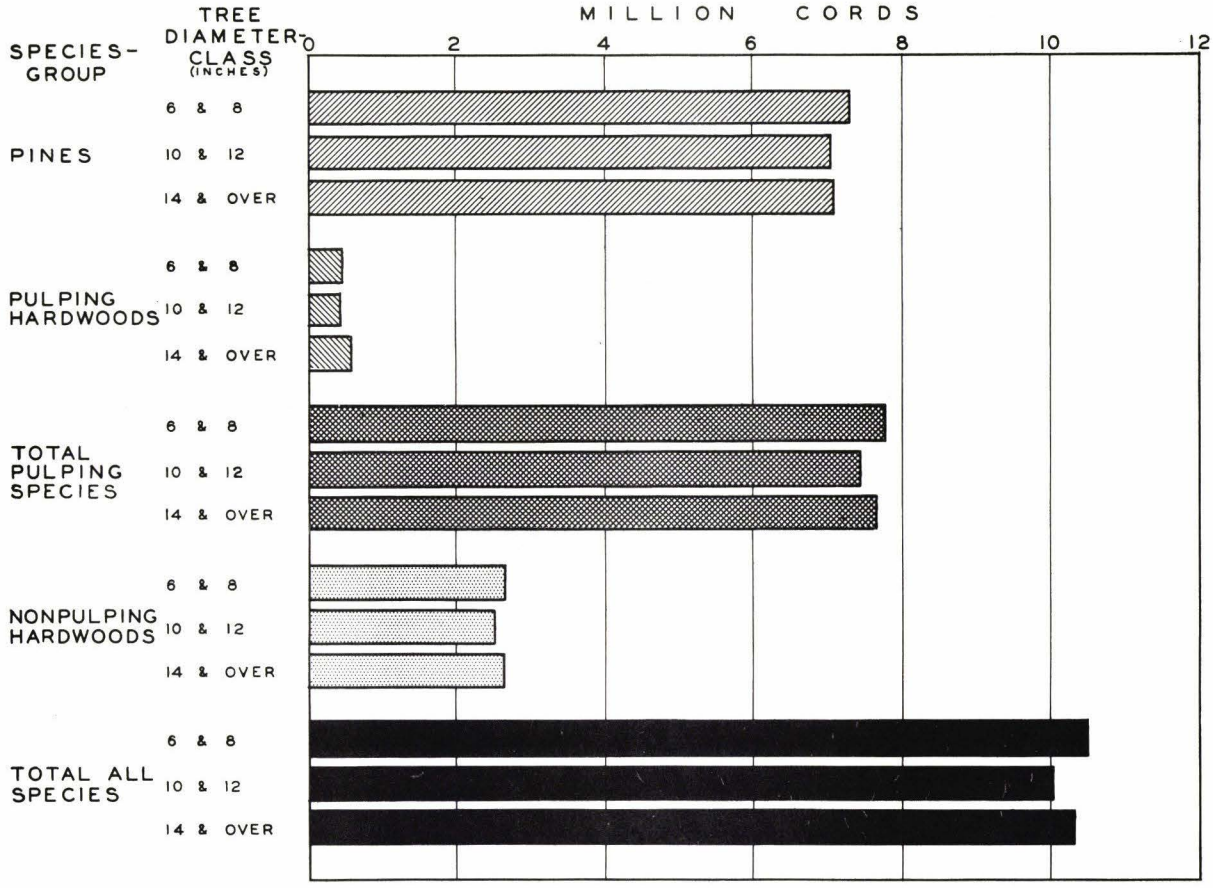

FIGURE 5— CORDWOOD VOLUMES OF PULPING AND NONPULPING SPECIES.

Pine poles and piles

The statistics relating to the supply of timber for pine poles and piles have already been presented in some detail[1/], but the following table summarizes the available information on this question.

Table 7. - Total number of pine poles or piles classified according to length and diameter

D.B.H. of trees (outside bark)	Pole or pile length (feet)						Total	Proportion of total
	20	25	30	35	40	45 or over		
Inches	- - - - - - - -		Thousand sticks			- - - - - - -		Percent
7.0- 8.9	5,007	835	513	64	-	-	6,419	40.9
9.0-10.9	3,335	991	729	104	52	-	5,211	33.2
11.0-12.9	1,226	967	645	194	194	-	3,226	20.6
13.0-14.9	77	246	178	155	85	31	772	4.9
15.0-16.9	-	1	26	23	12	6	68	.4
17.0-18.9	-	-	-	-	-	-	-	-
Total	9,645	3,040	2,091	540	343	37	15,696	100.0
Percent of total	61.5	19.4	13.3	3.4	2.2	.2	100.0	

Forest Increment

The volume of a forest stand is in a continuous state of change. The older trees grow in diameter and height, thus increasing their volume, while the younger ones are constantly attaining measurable volume. Negative volume changes occur when trees die, and when decay or injury cause loss of material in living trees. Forest increment is the balance between these various factors, and generally represents an increase in volume, although a decrement may occur in over-mature stands or in stands subject to the ravages of fire, insects, or wind.

Increment per acre of uncut stands

The values given in table 8 represent the net increment per acre in the various forest conditions, all forest types combined, of the stands in the unit, assuming no cutting during the year 1936. On the land in private ownership, the increment per acre may exceed the values given in the table, while on the National Forest land, with its poor sites, the increment is commonly less than is presented here. In recent years, over 500,000 acres of the Ouachita National Forest has been silviculturally improved by girdling the cull hardwoods. With expansion of this and other management practices, and with continued progress in fire prevention, it is reasonable to expect that the increment per acre can be increased materially on both private and public lands.

1/ "Pole and pile timber in the Pine-Hardwood Region-West" Forest Survey Release #28, Sept. 25, 1937, Southern Forest Exp. Sta., New Orleans, La.

The increment given in board feet occurred only on saw-timber material, while cubic-foot and cordwood volumes include the increment on the usable lengths of all pines above 5.0 inches d.b.h., under-sawlog-size hardwoods, and the saw-timber portion of hardwoods 13.0 inches d.b.h. and larger. No calculations of increment were made for cull trees or limbs of any species. Cordwood volumes include bark, but cubic-foot values are for wood only.

Table 8.- Average per-acre increment in 1936, in the various forest conditions (undisturbed by cutting)

Forest condition	Pine component			Hardwood component			Total per acre		
	Bd.ft.	Cu.ft.	Cords	Bd.ft.	Cu.ft.	Cords	Bd.ft.	Cu.ft.	Cords
Old growth:									
Uncut	68	15.9	.20	-1	-.8	-.01	67	15.1	.19
Partly cut	62	19.7	.25	6	1.9	.03	68	21.6	.28
Second growth:									
Sawlog size:									
Uncut	178	38.7	.50	9	3.9	.06	187	42.6	.56
Partly cut	113	24.8	.32	16	5.3	.08	129	30.1	.40
Under sawlog size	40	15.8	.21	4	3.1	.05	44	18.9	.26
Reproduction and clear-cut	2	.3	.01	negl.	.1	negl.	2	.4	.01
Weighted averages	88	22.5	.30	5	2.8	.04	93	25.3	.34

Forest increment of the unit

To determine the increment of forest stands subject to various degrees of cutting, it is necessary to deduct the proportion of growth on timber removed during the year, as well as allow for mortality and other natural losses. Table 9 shows the amount of wood that was added by growth during 1936, taking these factors into account. The values given in this table, however, do not represent the net amount by which the inventory of the growing stock increased during the year, as an almost equal amount of timber was cut and utilized during the same period, nearly offsetting the net growth.

In 1936 the total board-foot increment on the 7 billion feet of growing stock (lumber tally) amounted to 308,800,000 feet, of which 16 percent was in old-growth stands with an average stocking of 4,270 board feet per acre, and 65 percent was in second-growth sawlog-size stands that averaged 2,780 feet per acre. Stands at present under sawlog size, but averaging 280 feet per acre in scattered trees, produced 19 percent of the increment; this amounted to more than 60 million board feet.

In pine stands, the increment was positive in all conditions, both in board feet and cubic feet. In the hardwoods, all but the old-growth uncut stands increased their volume. In these mature hardwood stands the effect of mortality was to reduce the stand volume faster than new wood was added through growth, so that during 1936 there was a loss of 800,000 board feet or 460,000 cubic feet of material. It is problematical how much of this vol-

ume is an actual loss to the forest industries, as some of it occurs in trees and species that are not in immediate demand for commercial utilization. It is reasonable to suppose, however, that a large proportion of the trees that die in old-growth stands are large, mature, high-quality trees that might have been salvaged if they had been utilized when their declining growth rate indicated that their financial maturity was reached.

Table 9. - Forest increment in board feet and cubic feet in the various forest conditions, 1936

Forest condition	Saw-timber material			All material		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	- Thousand board feet -			- Thousand cubic feet -		
Old growth:						
Uncut	35,800	-800	35,000	8,340	-460	7,880
Partly cut	12,800	1,200	14,000	4,100	380	4,480
Second growth:						
Sawlog size	186,900	12,700	199,600	40,970	5,010	45,980
Under sawlog size	55,300	4,800	60,100	21,450	4,170	25,620
Reproduction and clear-cut	100	negl.	100	20	10	30
Total all conditions	290,900	17,900	308,800	74,880	9,110	83,990

The increment is expressed in standard cords (4 x 4 x 8 ft.) in table 10. This material is identical with that given in cubic feet in table 9, except that bark is included. In converting cubic feet to cords, factors of 90 cubic feet of wood and bark per cord were used for pine and cypress and 80 for hardwoods.

Table 10. - Forest increment in 1936, expressed in cords of rough wood, in the various forest conditions

Forest condition	Pine	Hardwood	Total
	Cords		
Old growth:			
Uncut	106,200	-6,900	99,300
Partly cut	52,600	5,600	58,200
Second growth:			
Sawlog size	530,200	77,800	608,000
Under sawlog size	283,900	65,300	349,200
Reproduction and clear-cut	300	100	400
Total all conditions	973,200	141,900	1,115,100

Forest Industries

Sawmills

Small, frequently moving, portable sawmills are the prevailing type in this area. In 1936, as determined by a field canvass of the entire unit, there were at least 157 sawmills with a capacity of less than 20 M board feet per day; many of these actually have a capacity of less than 10 M per day. It is estimated that these small mills operated at 40 percent of capacity during 1936, producing 51 percent of the lumber cut in the unit. These small mills are scattered throughout the unit (fig. 6) but tend to be concentrated near the larger towns and the main railroad lines. Usually the rough lumber produced is assembled at central concentration yards, where the product of several mills may be finished and kiln dried.

Four mills were found with capacities between 20 and 39 M board feet per day. All of these mills were cutting chiefly pine. They represent a fairly stable type of mill as contrasted with the smaller, portable mills. In 1936 they operated at about 40 percent of capacity and produced only 7 percent of the lumber cut.

There were three sawmills with a daily capacity of more than 40 M board feet. Two of these are large pine mills, operating in old-growth pine, each with facilities for cutting in excess of 100 M board feet per day. The other mill cuts hardwood entirely, producing about 60 M board feet per day when operating at full capacity. The two pine mills operated at more than 90 percent of capacity in 1936, while the hardwood mill cut at about 70 percent; during that year these three mills cut 42 percent of all the lumber produced in the unit.

Table 11. - Number of sawmills and extent of employment, classified according to size of mill, 1936

Daily (10 hrs.) rated capacity 1/	Mills 2/			Employment provided		
	Pine	Hardwood	Total	In woods	In mill	Total
Thousand board feet	Number			Thousand man-days		
Under 20	157	-	157	88	172	260
20 - 39	4	-	4	14	29	43
40 - 79	-	1	1	negl.	27	27
80 and over	2	-	2	101	142	243
Total	163	1	164	203	370	573

1/ The rated capacity indicated size of mill rather than actual average daily production.

2/ The data given here on the number of mills in the smallest class are estimates based upon all available records, supplemented by a field check.

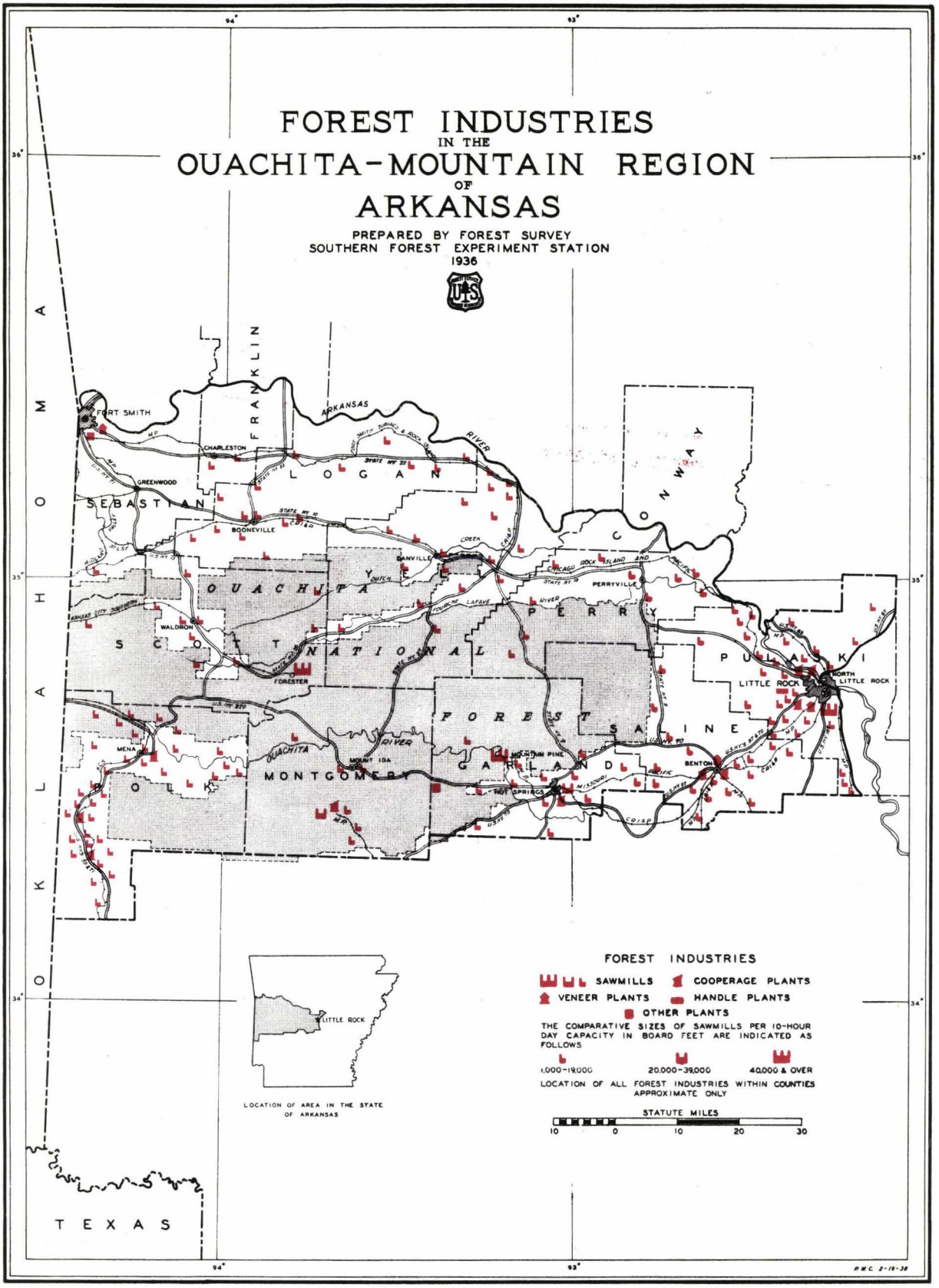

FIGURE 6 - FOREST INDUSTRIES MAP.

Other forest industries

Among the forest industries, cooperage plants rank next in numerical importance after sawmills. In 1936 there were 11 such plants in the unit, with consumptive capacities varying from 10 to 60 cords per day; they operated at about 60 percent of capacity for the year. Practically all of these plants, using white oak chiefly, make bourbon, oil, and other tight cooperage staves. None of the plants own forest land; all buy their timber, most of it delivered on the yard. The total wood used by these plants in 1936 amounted to 38,000 cords, of which 40 percent came from this unit and the remainder from adjoining Survey units, mostly in Arkansas.

There are 3 veneer plants in the unit, located at Little Rock, Benton, and Fort Smith. Their daily capacities vary from 6 to 9 M board feet green lumber tally; their combined production in 1936 amounted to 70 percent of capacity. Red and black gum, and cottonwood are the chief species used. Two of the plants secure about half their wood requirements from this unit, while the other plant draws its entire supply from southwest Arkansas outside the unit. The bolts used, which are large and of good quality, are usually purchased delivered at the mill yard.

Miscellaneous establishments include 2 hardwood dimension plants, 5 furniture plants, and 10 shingle mills. Hand-made products obtained directly from the forest include hewed cross ties, pine poles and piles, mine props, fence posts, and fuel wood. Most of the cross ties are purchased by local railroads, while the poles and piles are shipped to adjacent treating plants, and to plants in the North and East. Some fence posts are produced for sale to commercial treating plants, but most of them, as is the case with fuel wood, are for local use. The mine props are used mainly in the coal mines centering around Poteau, Ark. Plants outside the unit but drawing raw material from it include one handle mill and one excelsior mill. Some dogwood is also shipped to Memphis, Tenn., for manufacturing shuttle blocks.

Table 12 gives a summary of the production and employment data occasioned by the forest industries in 1936. The amount of material shown as produced or used by the sawmills and by the veneer and cooperage plants represents the production of these plants regardless of the source of their wood supply, while the material shown for the remaining commodities comes entirely from the Survey unit. The woods employment shown is based upon the material cut from within the unit, while the mill employment is the total labor furnished by the mills within the unit, irrespective of the source of the wood supply.

Table 12. - Production and employment, 1936

Kind of plant or commodity	Number of plants	Amount produced or used	Employment provided		
			In woods	In mill	Total
		M bd. ft.	- - Thousand man-days - -		
Sawmills	164	196,400	203	370	573
Veneer	3	4,000	4	15	19
		M pieces			
Cross ties	-	524	76	-	76
Poles and piles	-	23	6	-	6
Fence posts	-	1,129	16	-	16
		M cords			
Cooperage	11	38	18	67	85
Fuel wood	-	393	412	-	412
Miscellaneous 1/	17	2/45	73	8	81
Total	195		808	460	1,268

1/ Includes 2 hardwood dimension plants, 5 furniture plants, and 10 shingle mills.

2/ Includes material used for mine props, excelsior, shingles, and shuttle blocks.

Employment

Table 12 shows that the total employment furnished by the forest industries during 1936 amounted to 1,268,000 man-days. If 250 days is considered a working year, this is equal to 5,100 man-years, but since most employees work only part time in the forest industries, the actual number of men employed is much greater than is thus indicated. The sawmill industry contributed 45 percent of the total labor, and if a wage of $2.00 per man-day was paid, this industry returned over a million dollars to wage earners within the unit. If the timber supply and economic conditions should warrant capacity operation of the present sawmills, the return in wages would be approximately doubled. In 1936, the cut on the Ouachita National Forest amounted to about 25,000 M board feet, lumber tally, providing 66,000 man-days of employment. The allowable cut (approximately 60 percent of the increment) is about 35 million board feet, which would provide about 92,000 man-days of labor annually.

Utilization Drain

Although table 9 shows that the increment in the unit amounted to nearly 309 million board feet of sound material during 1936, this does not represent the net amount by which the timber stand increased in volume during the year. Wood used in 1936 by the forest industrial plants or consumed in the form of fuel wood, fence posts, cross ties, poles, and piles, amounted to 277 million board feet and nearly equaled the volume of increment. This utilization drain includes the material cut from the growing stock —— both the sound usable material left in felled trees after logging as well as that utilized —— but does not include any material cut from limbs or from dead or cull trees. In table 13, the utilization drain is shown by commodity, with the drain on the saw-timber section of the tree, including both the utilized and wasted portions, expressed in board feet. The volumes given in cubic feet inside bark include drain on saw-timber material, upper stems of sawlog-size pines, and small trees under sawlog size but at least 5.0 inches d.b.h.

Table 13. - Utilization drain from sound trees, 1936

Commodity or use	Saw-timber material			All material		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	- Thousand board feet -			- Thousand cubic feet -		
Lumber	211,500	3,900	215,400	38,110	600	38,710
Cross ties	11,800	16,500	28,300	2,030	2,710	4,740
Poles and piles	2,800	100	2,900	510	10	520
Veneers	-	2,900	2,900	-	420	420
Cooperage	800	10,000	10,800	160	1,460	1,620
Misc. manufactures	100	100	200	1,010	2,140	3,150
Fuel wood	7,000	3,100	10,100	3,090	4,730	7,820
Fence posts	-	2,100	2,100	310	400	710
Misc. farm use and land clearing	3,100	900	4,000	1,570	740	2,310
Total	237,100	39,600	276,700	46,790	13,210	60,000

Comparison of Increment and Drain

Table 14 is a summation of the effect of growth, mortality, and utilization drain upon the board-foot growing stock during 1936. The values are expressed in lumber tally.

Table 14. - Balance between increment and drain of saw-timber material

Item	Pines	Hardwoods	Total
	Thousand board feet		
Net growing stock, Jan. 1, 1936	5,756,500	1,178,500	6,935,000
Growth, 1936	316,700	52,900	369,600
Mortality, 1936	25,800	35,000	60,800
Forest increment, 1936	290,900	17,900	308,800
Utilization drain, 1936	237,100	39,600	276,700
Net change in growing stock, 1936	53,800	-21,700	32,100
Net growing stock, Jan. 1, 1937	5,810,300	1,156,800	6,967,100

As shown in the above table, the pine growing stock increased by about 54 million board feet during 1936; while the hardwoods showed a decrease of nearly 22 million feet. Apparently there is an adequate pine supply for present industries, but this is not the case. Approximately 90 percent of the pine board-foot drain was caused by the lumber industry, and about half of this lumber drain was from old-growth timber cut by two large mills within the unit and two ajacent to the unit in the south. Reference to table 9 shows that increment in old-growth pine is slightly less than 50 million board feet, which means that in 1936 these four mills were cutting the old-growth timber twice as fast as it was growing. While the drain in the second growth amounted to only 50 percent of the increment, a part of the surplus increment may be needed by the present lumber industry to supplement its waning supply of old-growth timber. Also some part of the surplus increment in second-growth pine should be reserved from cutting to build up the growing stock. It is doubtful whether the large pine mills will continue their operations on the present basis after the old-growth timber is gone. The Forest Service has been trying for several years to work out a cooperative plan with these large operators, in which their operations would be placed on a sustained-yield basis through the utilization of some of the old-growth timber on the Ouachita National Forest, but the practical attainment of such a plan seems difficult. Present Forest Service policy recognizes the needs of the smaller but more permanent concentration plants such as those located at Booneville, Waldron, Eagleton, Mena, Norman, and Hot Springs, since in this way real assistance is given to the local industries and people in maintaining permanent operations.

The hardwoods are being overcut, both in the old-growth and second-growth stands. In addition to the fact that the drain exceeds the increment, is the disquieting truth that a large proportion of the hardwood drain is centered upon a very few species and on only their highest-quality trees, while the increment shown is on all species. In 1936, for example, 25 percent of the total board-foot drain of hardwood was for cooperage, practically all of which was of high-quality white oak. Cross ties accounted for an additional 42 percent of the drain, and a large proportion of these were cut from white oak and the better red oaks. As a result of this concentration of drain on a few species, there has been a constant tendency for the hardwood stand to degenerate in quality.

The comparison of increment and drain, for the total sound-tree growing stock above 5.0 inches d.b.h. is expressed in cubic feet (inside bark) in table 15. Here also the net result is to increase the growing stock, since the gain in the pine growing stock more than balances the loss in the hardwoods. The actual situation is comparable to that described above for board feet. In 1936 there was no pulpwood drain from the unit, but it is likely that a demand for pulpwood will develop from the pulpmills in the southern part of the State.

Table 15. - Balance between increment and drain in cubic feet

Item	Pines	Hardwoods	Total
	- - - Thousand cubic feet (i.b.) - - -		
Net growing stock, Jan. 1, 1936	1,664,570	605,650	2,270,220
Growth, 1936	83,380	28,330	111,710
Mortality, 1936	8,500	19,220	27,720
Forest increment, 1936	74,880	9,110	83,990
Utilization drain, 1936	46,790	13,210	60,000
Net change in growing stock, 1936	28,090	-4,100	23,990
Net growing stock, Jan. 1, 1937	1,692,660	601,550	2,294,210

Summary and Outlook for the Future

In the area covered by this report, agriculture is a submarginal industry. At present nearly 70 percent of the land area supports forest growth, and it is probable that this percentage will increase in the years to come. Forests long have been the chief use of the land. This use must be continued if the land is to contribute its share to the support of the people. Permanent yields of forest products are essential in a planned economy based upon the timber resource, and this unit is fortunate in that 30 percent of the forest area is in public ownership, managed for the express purpose of assuring a continuous wood supply.

Although in 1936 the forest increment amounted to 32 million board feet more than the drain, the situation is not entirely satisfactory. On the National Forest the present allowable cut is set at about 60 percent of the increment, because the portion of the growth accruing upon the recently purchased heavily cut-over land is not considered in calculating the increment or in setting up the immediate cutting budget; furthermore, a portion of the increment on the area to be logged is being reserved to build up the growing stock which is now below normal. These two measures are desirable, in that eventually the forest stand will be increased materially and a greater annual yield will result, particularly when those stands now omitted from the cutting budget become merchantable. The conservative Forest Service policy of management on the Ouachita Forest will insure a continuous supply of timber on only one-third of the forest land of the unit; it cannot in so doing provide for the future supply on the remaining two-thirds now in private ownership. The forest industries dependent upon this portion of the unit must adopt forest management policies designed to perpetuate their timber supply or eventually face a reduction in operations. While clear-cutting is by no means the rule on all private land, several of the larger owners have cut such a large proportion of their forest capital that it will be difficult, if not impossible, for them to maintain a continuous operation. The cutting practice on practically all private land is open to improvement if the supply of timber is to be maintained or increased.

A disquieting result of the too rapid harvesting of the timber on private land is its effect upon regular employment. During 1936, a large proportion of the labor used by the forest industries in the unit was employed directly in the utilization of timber held in private ownership. Continued over-cutting on private land inevitably will reduce the opportunity for future employment in the forest industries and, unless needed adjustments are made, it is probable that within a relatively few years at least two large operators will cut-out, leaving two towns virtually abandoned.

One means of prolonging the life of these large operations lies in perfecting cooperative agreements between the Forest Service and the private operators for the coordinated management of National Forest and private timberland in sustained-yield working circles. Local conditions, such as the remaining supply of timber in private ownership, location of plants in relation to National Forest timber and to existing or proposed transportation facilities, and the financial status and management policies of the individual companies, all affect the feasibility of such a plan and must be thoroughly evaluated in its practical application. On the other hand, it is questionable whether the Forest Service should increase its cut to keep these two large operations going awhile longer, or whether it should handle its present forest land conservatively with the ultimate object of providing needed employment for smaller but more stable operations, when the large mills finally cut out. Actual conditions in the unit seem to justify the adoption of the latter course.

While the National Forest has a definite responsibility in the maintenance of forest industries in the unit, the owners of private timberlands have even a greater one. The National Forest can only partly ameliorate the situation; in the long run the maintenance of the greater part of the forest growing stock rests directly upon the private operators and timberland owners who control the forest practices on two-thirds of the forest land in the unit. The cutting practices of the present sawmill industry, however, are not conducive to the establishment of sustained yield on private lands. About 40 percent of the pine lumber produced is cut by two large companies, which, because of various factors, are operating on a liquidating basis. Also, of the 164 sawmills in the unit, 157 are small portable mills, only a few (if any) of which hold forest land in sufficient quantity to justify growing successive crops of timber; nor do they have, as a rule, the financial stability to buy lands as the basis for such management. The small mills are, in reality, simply an outlet or market for the timber of the land owners, and it is incumbent upon the land owner to regulate the cutting of his forest if he expects to manage it for a continuous supply of material.

When the foregoing facts are considered —— those relating both to private and to National Forest land —— it appears that a reduction in the cut of lumber must occur eventually in this unit if there is no marked change for the better in the management of private forest land. The cut on the National Forest will be maintained on a sustained-yield basis and will be relatively constant throughout a given cutting cycle although it can be increased eventually. Generally it will be allocated so that a certain number of plants can be maintained continuously, but these favored plants will, of necessity, equal only a small part of those now operating in the unit. Those sawmills dependent entirely upon old-growth timber in private ownership probably will be forced to close down upon the exhaustion of the virgin stands, although there may be an opportunity to maintain reduced operations using second-growth timber and producing material of lower quality. With the large mills out of production the numerous small portable mills can continue to cut second-growth timber at the present rate, or even at a greater rate, on private land for a long time.

In order to help meet the demand for continuous employment and to divert to another part of the growing stock some of the excessive industrial drain now largely concentrated on the best trees and most valuable species, new plants are needed to make use of the low-quality material so abundant in the forests of the unit. Utilization of the inferior hardwoods offers the best opportunity from a supply standpoint, but there is also an opportunity to increase the use of small low-quality trees removed as thinnings from pine stands. Such material is suitable for the manufacture of rayon, paper, liner board, building board, or plastics.

If the situation is to be improved, several measures must be given wide-spread application. Basic to any timber-growing program is the need for a comprehensive and effective system of fire control. On publicly owned lands, fires are held within reasonable limits. On the private land, the State, in cooperation with the Federal Government, is rapidly extending a fire-control system. If the forests are to be built up to their full productivity, it is necessary that <u>all</u> forest land in the unit should receive adequate protection from fire at the earliest date possible.

Another essential need is a program of education, carried to the timberland owner, the forest operator, and the general public, designed to acquaint all concerned with the profits, principles, and applications of good forest practice. The existing forestry Extension Service should be expanded and organized so that it can carry forward its share of this work. The Arkansas State Forestry Commission, which recognizes the need of education and of assistance to private owners and operators, has recently organized a department for the exclusive purpose of bringing forestry methods directly to them. The work of this department should be expanded and continued. The Ouachita National Forest serves as an excellent demonstration area in good forest practices, but there is a place for strategically located State Forests to serve as demonstration areas in addition to the National Forest.

A planting program to reforest all, or the greater part, of the 310,000 acres of idle and abandoned fields is needed. Most of the fields are suitable only for pine, but those located in the more fertile stream valleys may meet the requirements of white oak and other hardwoods. The State Forestry Commission should provide planting stock at reasonable cost and, through its field officers, should encourage and advise private owners who wish to build up their forest acreage by planting.

With the general application of fire control and improved forestry practices throughout the unit, there will be a gradual increase in the stand per acre and a resulting increase in the increment. The opportunity for increasing the forest crop is apparent; figure 2 shows that the present average stand contains only 55 percent of the volume of a managed stand, indicating that through management the increment could be nearly doubled. This can be attained, however, only by the continuous and concentrated efforts of public agencies and of private owners and operators.